

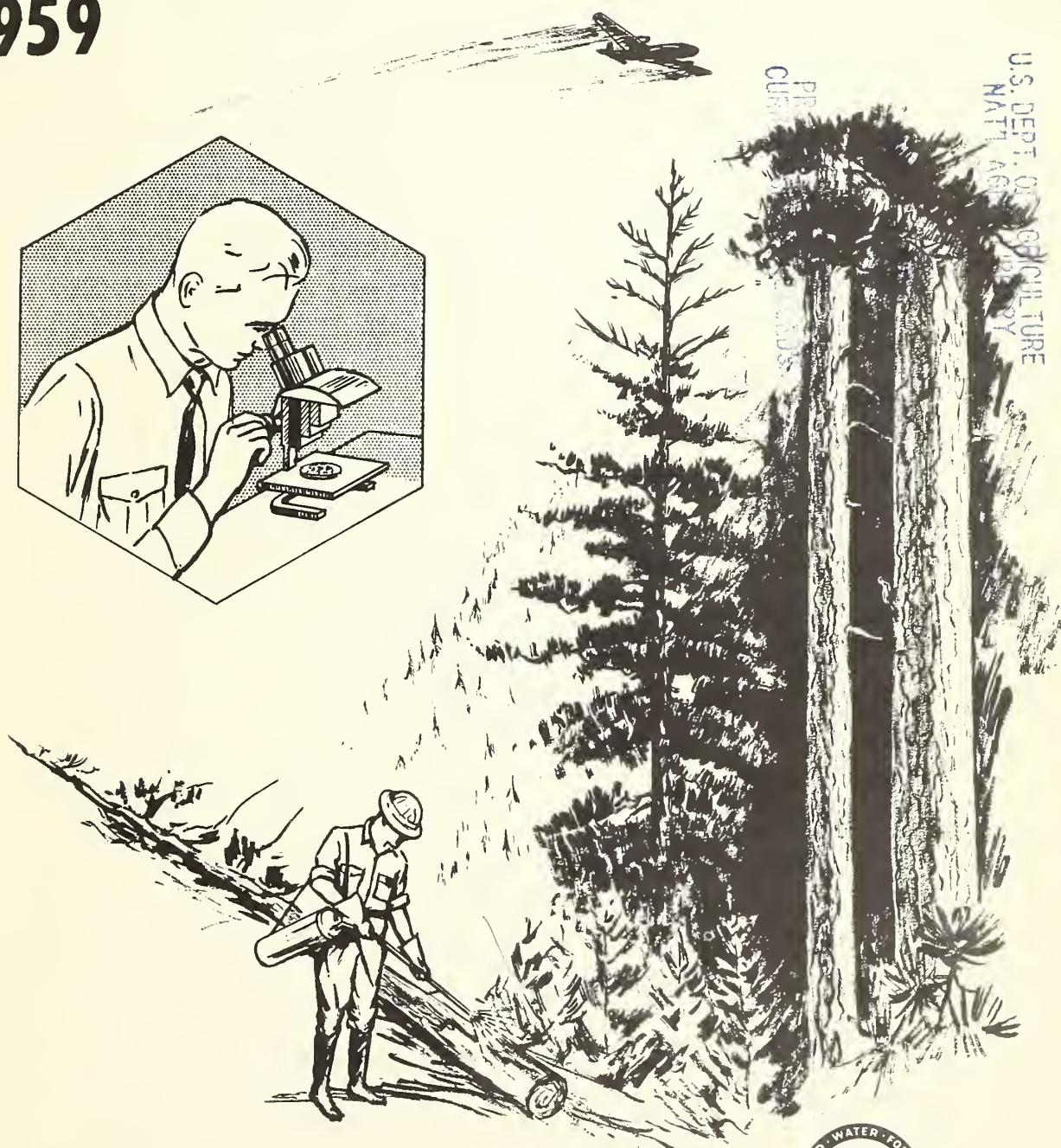
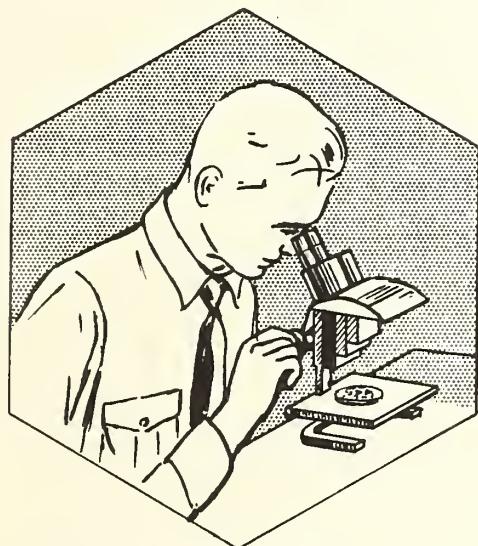
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FOREST INSECT CONDITIONS IN THE UNITED STATES

1959



U. S. DEPARTMENT OF AGRICULTURE - FOREST SERVICE



FOREST INSECT CONDITIONS IN THE UNITED STATES, 1959

Compiled by the Division of Forest Insect Research

This report of forest insect conditions in the United States is a compilation of material submitted by the forest and range experiment stations of the Forest Service, U.S. Department of Agriculture. The information was obtained from Forest Service aerial and ground surveys, which were supplemented by reports from Federal, State, county, and private agencies, and many individuals.



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THE IMPORTANT INSECTS: THEIR TYPES AND ACTIVITY

Bark Beetles

Bark beetles, as a group, are the most destructive forest insects in the United States. They increase rapidly and kill trees of high value, and so require costly control measures each year. Losses are heaviest in the West, but are also important in other regions, particularly in the South and Southeast.

The MOUNTAIN PINE BEETLE, a serious enemy of the important pine species in the Western States, was again destructive in many areas in 1959. Losses in sugar pine stands in California were the highest in years; the most critical areas were on the western slopes of the Sierra Nevada. In stands of old-growth western white pine in northern Idaho and western Montana, 1 to 5 percent of the green stand volume was killed. Beetle populations remained heavy, or increased, in ponderosa and lodgepole pines on the Fremont, Mount Hood, and Willamette National Forests in Oregon, and on the Gifford Pinchot, Mount Baker, and Wenatchee National Forests in Washington. The outbreaks of 1958 on lodgepole pine in California expanded. A new infestation center appeared in Yosemite National Park. Outbreaks increased in limber pine on the Shoshone National Forest in Wyoming, and severe killing continued in stands of lodgepole pine in western Wyoming and in northern and southern Idaho. Infestations in ponderosa pine persisted on the Boise National Forest, Idaho, and at Lake Tahoe, Nevada, in spite of control efforts. Other outbreaks centered at Lassen Volcanic National Park, the Plumas National Forest, and the Warner Mountains in California and in second-growth stands in southern Oregon.

Outbreaks of the ENGELMANN SPRUCE BEETLE developed in several Western States, including Colorado, where most infestations were associated with logging. The San Juan and Uncompahgre National Forests, for example, had 21,150 infested trees in areas adjacent to timber sales. Hibernating beetles on the Gunnison, Rio Grande, and Routt National Forests are due to emerge from cull logs in great numbers and attack standing trees during the summer of 1960. On the Bridger National Forest in Wyoming and the Uinta, Ashley, Wasatch, Payette, and Manti-LaSal National

Forests, Utah, logging, chemicals, and trap trees were used to combat large-scale epidemics. Beetles remained active in stands in northern Idaho and western Montana, but killed fewer trees than in previous years in all areas except the Kootenai National Forest.

DOUGLAS-FIR BEETLE populations were low in most stands in northwestern California. The widespread infestation on the Siskiyou, Rogue River, Umpqua, and Siuslaw National Forests in Oregon showed a reduced intensity. Beetles attacked windthrown trees in southwestern Washington, and broods in that material are expected to move into standing timber in 1960. Beetle activity declined on the Pike, Rio Grande, Roosevelt and San Isabel National Forests, Colorado, but increased on the Shoshone National Forest and the South Bighorn Mountains, Wyoming. Losses on the Dixie National Forest, Utah, and in the Swan River Valley, Montana, continued high. Scattered infestations remained in some of the Douglas-fir stands in New Mexico and Arizona.

Outbreaks of the BLACK HILLS BEETLE continued on the Dixie National Forest and at Bryce Canyon National Park, Utah, and an estimated 2,400 beetle trees are a continuing threat. Infestations increased in scope and severity on about 63,000 acres of ponderosa pine along the Front Range of the Rocky Mountains in Colorado.

The WESTERN PINE BEETLE caused serious losses of ponderosa pine in Washington, especially on the Yakima Indian Reservation and the Gifford Pinchot National Forest. Fourteen epidemic centers covered 131,500 acres of the Yakima Reservation. One of the worst outbreaks in recent years occurred in California on the Sierra National Forest, where one area of 1,000 acres contained an estimated 1,000 beetle trees. Ponderosa pine suffered unusually high mortality on 100,000 acres around Burney, and heavy group killing occurred on about 150,000 acres on other parts of the Lassen National Forest. Smaller outbreaks developed on public and private lands elsewhere in California.

Outbreaks of the JEFFREY PINE BEETLE in combination with the

CALIFORNIA FLATHEADED BORER continued in Jeffrey pine on the Sequoia National Forest, California, where tree mortality on 100,000 acres reached about 20 million board feet. High-risk trees were cut ahead of anticipated infestation as an indirect control. Smaller infestations in California are on the Inyo National Forest, the Lassen Volcanic National Park, and in Sierra, Shasta, San Bernardino, Riverside, and San Diego Counties.

The BLACK TURPENTINE BEETLE continued to threaten high-value pines in cutting areas throughout the mid-South. From east Texas through Alabama, infestations were high on most national forests and on many State and private lands. Toxic oil sprays applied to infested stumps and the bases of residual trees kept losses low in most areas.

Populations of the SOUTHERN PINE BEETLE increased in the Big Thicket of east Texas. In spite of suppressive controls, at least 14 infestation centers remained at the year's end in areas made inaccessible by heavy rains. The spread of beetles from these uncontrolled spots will increase the danger of a major blowup in 1960. Fall surveys in several North Carolina counties showed an increase in beetle activity and conditions are potentially serious. Elsewhere in the South and Southeast, southern pine beetle populations were low.

Other species of bark beetles damaged coniferous stands throughout the country. The ALASKA SPRUCE BEETLE caused substantial losses to spruce on part of the Kenai Peninsula, Alaska; the ENGRAVER BEETLES threatened localized areas in the West, South, and Southeast.

Defoliators

The SPRUCE BUDWORM, the most widespread major forest insect in the country, killed and damaged trees in coniferous stands from coast to coast.

The budworm spread eastward in Maine into most of the 302,000 acres of spruce-balsam fir stands aerially sprayed in 1958. The insect defoliated balsam fir on 82,000 acres outside of the sprayed area, and damaged 175,000 acres of adjacent stands. In Minnesota, budworm activity increased, with about a million acres moderately to severely defoliated. Infestations continued light in Michigan and Wisconsin.

In the Intermountain Region, 4 million acres remained infested. In Montana, most of the Douglas-fir type east of the Continental Divide was defoliated, including much of the acreage sprayed several years ago; only minor damage was apparent west of the Divide. Top-killing occurred in stands of grand fir in the Craig Mountain area in Idaho. On the Payette, Salmon, Sawtooth, and Targhee National Forests, budworm defoliated trees in a half-million acre area.

Defoliation of Douglas-fir and true fir in Colorado increased to 350,000 acres. Infestation areas more than doubled in New Mexico, to about 703,000 acres. Populations in these States probably will expand in 1960, developing into a severe situation in northern New Mexico.

The budworm persisted in white fir stands in the Warner Mountains, California, for many years without causing serious damage. This year, however, defoliators

damaged about 2,800 acres. Infestations in the Pacific Northwest declined to 209,000 acres; defoliation was light except on the Fremont National Forest, Oregon.

Various species of sawflies defoliated coniferous stands and young pine plantations in many areas of the country, being especially prevalent in the East. The RED-HEADED PINE SAWFLY was unusually destructive, and had to be controlled by aerial spraying with DDT in several mid-South States. An epidemic of VIRGINIA PINE SAWFLY spread over 14 million acres of shortleaf, Virginia, and pitch pines in Maryland and Virginia and is moving southward into North Carolina. Enough host material is available to permit greater population increases and further extension southward. The LARCH SAWFLY defoliated tamarack in the Lake States for the tenth consecutive year. Continued, unabated outbreaks may destroy commercial stands of tamarack within a decade.

Other species of defoliators infested conifers and hardwoods countrywide. Some of the more destructive ones were the BLACK-HEADED BUDWORM in Alaska, the DOUGLAS-FIR TUSSOCK MOTH in New Mexico and Arizona, PINE NEEDLE MINERS in California and Idaho, and the JACK-PINE BUDWORM in the Lake States. The FOREST TENT CATERPILLAR defoliated hardwood stands in extensive areas of the Northeast and South, but was less active in Wisconsin, Minnesota, and Michigan than in previous years. The ELM

SPANWORM defoliated oaks and other hardwoods over a large area in the Southeast, but the intensity of feeding decreased. The program to eradicate the GYPSY MOTH from the westernmost edges of its range in the Northeast and from localized areas

in Michigan continued; 80,000 acres were aerially sprayed in New York and 20,000 acres in Michigan. New infestation areas west and southwest of Lansing, Michigan, will require spraying of about 10,000 acres there in 1960.

Sucking Insects

PINE SPITTLEBUGS and APHIDS were locally important in some areas; the spreading of the BALSAM WOOLLY APHID and the resulting timber losses are causing growing concern. In Vermont, New Hampshire, Maine, and New York, the woolly aphid is one of the most destructive enemies of balsam fir, slowing growth and killing trees. Increasing mortality of Fraser fir in the Southeast is of special concern, par-

ticularly in important scenic, recreational, and watershed areas in western North Carolina. In Washington and Oregon, the aphid spread over approximately 160,000 acres, killing trees in many of the subalpine fir stands. No satisfactory control for the aphid has yet been developed. Imported predaceous insects have now become well established in outbreak areas in the East and West, and may lead to some measure of control.

Miscellaneous Insects and Mites

The PINE TIP MOTHS in the South and the WHITE PINE WEEVIL and EUROPEAN PINE SHOOT MOTH in the Northeast and Michigan continued to slow the growth of young conifers in many plantations. The European pine shoot moth appeared for the first time in the Pacific Northwest.

The PINE REPRODUCTION WEEVIL damaged young plantations in California. The PINE ROOT-COLLAR WEEVIL and other weevil species were increasingly destructive in Wisconsin.

The ALLEGHENY MOUND ANT and the TEXAS LEAF-CUTTING ANT killed young

pines in the Central and Southern States, respectively, and a PINE LEAF CHAFER caused severe browning of loblolly pine foliage in North Carolina. CONE AND SEED INSECTS destroyed much of the coniferous seed crop in California, the Lake States, and the South reducing the amount of seed available for nurseries, seeding, and natural regeneration.

Severe browning of southern pine foliage by SPIDER MITES covered over 10 million acres in northern Louisiana and southern Arkansas. Light infestations of the mite also continued in some Douglas-fir stands in Montana.

CONDITIONS IN FOREST REGIONS, 1959

Alaska

Highlights

1. Infestations by the black-headed budworm and hemlock sawfly pose a new threat to the hemlock-spruce stands in southeast Alaska.
2. The Alaska spruce beetle became epidemic on a part of the Kenai Peninsula.
3. The spear-marked black moth population dropped to low endemic levels near Fairbanks.

Defoliators Threaten Hemlock-Spruce Stands

Sampling of insect populations during the summer disclosed large numbers of the black-headed budworm, *Acleris variana* (Fern.), and the hemlock sawfly, *Neodiprion tsugae* Midd., in the hemlock-spruce stands of southeast Alaska. Heaviest populations were in the Cholmondeley Sound area; other high populations were in the vicinity of Kasaan Bay and Portland Canal. Other stands in this general area probably harbor large populations of these pests.

Earlier epidemics of the budworm and sawfly that occurred from 1948 to 1955, moved from the southern end of the panhandle northward throughout most of southeast Alaska. Damage to hemlock stands was variable, but moderate to heavy top-killing and tree-killing occurred on more than 100,000 acres (fig. 1). This damage varied from about 10 percent of the stand on moderately defoliated areas to over 50 percent on those more heavily hit. Damage to the spruce stands was much less.



Figure 1. Black-headed budworm and hemlock sawfly damage to hemlock-spruce stands in Alaska, 1948-1955. Grayish trees are killed or top-killed.

Sampling of larval broods in 1959 showed parasitism of the budworm near 20 percent, but almost none for the sawfly. Thus, barring heavy brood mortality caused by other natural factors during the winter, populations of both insects should increase greatly in 1960.

Spruce Beetle Invades Recreational Area

The Alaska spruce beetle, *Dendroctonus borealis* Hopk., caused heavy loss of white spruce and Lutz spruce on parts of the Kenai Peninsula. Several thousand trees were attacked and killed in the northeastern part of the Kenai National Moose Range and within several drainages of the adjacent Chugach National Forest.

The Fish and Wildlife Service in Alaska considers the spruce loss on the moose range desirable because dense stands hinder management of the herds. However, inasmuch as losses on the national forest are within recreational areas, controls are planned. Infested trees will be logged or sprayed with toxic oils.

Logging Triggers Engraver Outbreak

Several thousand young white spruce trees were killed by *Ips* engraver beetles, presumably *Ips interpunktus* (Eichh.), near the Gerstle River along the Alaska Highway. The beetles, apparently attracted to logging slash and to logs at nearby sawmills, developed large populations in this material and attacked nearby trees.

Virus and Parasites Control Birch Defoliator

The spear-marked black moth, *Eulype hastata* L., a looper which lives gregariously in webbed leaves of paper birch, defoliated considerably less forest in 1959 than in the widespread epidemic of 1958. Extensive ground sampling indicated only light feeding confined to a few areas along the Alaska Highway between Tok and Delta Junctions. The epidemic collapsed mostly because of a granulosis virus and insect parasites (primarily braconid and ichneumonid wasps of the genera *Meteorus* and *Aoplus*).

PACIFIC NORTHWEST

Highlights

1. The trend of spruce budworm infestation continued downward on all areas except the Fremont National Forest in southern Oregon. No aerial spraying will be done in 1960.

2. The Douglas-fir beetle outbreak in southern Oregon declined, and should subside further in 1960. In southwestern Washington, this beetle attacked windthrown timber extensively and will probably spread to green timber in the spring.

3. Tree-killing by the western pine beetle varied. The Yakima Indian Reservation and adjoining areas contained the only serious infestations.

4. Outbreaks of the mountain pine beetle flared up in young stands of ponderosa pine in various parts of the region.

5. Tree-killing by the balsam woolly aphid decreased in Oregon but the aphid populations increased, indicating a recurrence of heavy kills in the future.

6. The European pine shoot moth was discovered for the first time in the Pacific Coast States. Ornamental pines in the vicinity of Seattle, Washington, were infested.

Trend of Douglas-Fir Beetle Down in Oregon and Up In Washington

The widespread outbreak of the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk., on and near the Siskiyou, Rogue River, Umpqua, and Siuslaw National Forests in southern Oregon declined from the peak reached in 1958. Tree-killing is significant on approximately 325,000 acres but inspections in June showed light attacks and poor brood development, indicating a continuing downturn in population.

In southwestern Washington, broods are developing in timber that was windthrown over a wide area in 1958 (fig. 2) and many green trees will probably be killed in 1960. While many of the broken and uprooted trees on the Snoqualmie National Forest and adjacent private lands have been salvaged, efforts by public and private agencies must be continued to prevent increased tree-kills in other areas.

Smaller outbreaks centered on the Umatilla National Forest, Oregon, and on the Okanogan and Wenatchee National Forests and Colville Indian Reservation, Washington.



Figure 2. Windthrown Douglas-fir in a reserve stand along a cutting boundary. The Douglas-fir beetle often increases to epidemic proportions in this situation.

Western Pine Beetle Infestations Variable

The western pine beetle, *Dendroctonus brevicomis* Lec., killed much ponderosa pine timber on the Yakima Indian Reservation and in adjacent stands on the Gifford Pinchot National Forest, Washington. The insect killed groups of 20 or more trees of all age and vigor classes in 14 epidemic centers on 13,520 acres of the Yakima Reservation. On the Gifford Pinchot National Forest, infestation centers expanded and new ones appeared; the largest was an extension of the epidemic on the Yakima Reservations. These buildups, plus those on Indian lands, suggest further heavy losses unless infested and high-risk trees are logged, or other methods are used for suppression. Elsewhere in the region, the trend of infestations varied.

Pine Stands Depleted By Mountain Pine Beetle

Ponderosa, lodgepole, and western white pines are the most common hosts of the mountain pine beetle, *Dendroctonus monticolae* Hopk., and outbreaks occurred in stands of all of these species during the year. Beetle populations were high in pole-size ponderosa pine on the Fremont National Forest, Oregon, and in several other areas in both Oregon and Washington. Most pines in heavily infested stands, already weakened by overstocking and competition from white fir, will probably die.

Mortality also was severe in stands of white pine and lodgepole pine on parts of the Gifford Pinchot, Mount Baker, and Wenatchee National Forests, Washington, and on the Mount Hood and Willamette National Forests, Oregon. In these and other locations, stands are depleted rapidly because the beetle continues its attacks in an area until most of the susceptible trees are killed. In many cases, control is not attempted because of the low value of affected stands.

Other Bark Beetles Active In Coniferous Stands

Infestations of the Engelmann spruce beetle, *Dendroctonus engelmanni* Hopk., remained low. The main centers occurred in subalpine stands on the Snoqualmie and Wenatchee National Forests, Washington, and the Wallowa-Whitman and Willamette National Forests, Oregon. Generally, timber values in infestation areas are too low to warrant costly control. There are exceptions, of course, especially in recreational areas.

Damage by the Oregon pine engraver, *Ips oregonis* (Eichh.), increased in the region but stands of ponderosa pine on the Wallowa-Whitman National Forest in Oregon were hardest hit. Outbreaks of the fir engraver, *Scolytus ventralis* Lec., were more extensive in many stands than in 1958, but remained relatively unimportant because of the low value of trees in the affected areas. Local centers of tree-killing by the Douglas-fir engraver, *Scolytus unispinosus* Lec., increased in number in drought-weakened young stands on the Mount Hood National Forest, Oregon. Light outbreaks of silver fir beetles, *Pseudohylesinus granulatus* (Lec.) and *P. grandis* Sw., increased for the second year on and near the Mount Baker National Forest, Washington. Although tree-killing by the latter species was far short of that in the 1951 to 1955 epidemic, an uptrend was evident. Direct control of these beetles is usually impractical or unnecessary, and losses are kept within tolerable levels by the proper handling of logging slash and the salvage of affected timber.

Trend Of Spruce Budworm Infestations Continues Downward

Defoliation by the spruce budworm, *Choristoneura fumiferana* (Clem.), of Douglas-fir and subalpine and grand firs continued its downtrend on the Wallowa-Whitman and Malheur National Forests, Oregon, and the Yakima Indian Reservation, Washington.

But infestations more than doubled in acreage and increased in intensity on the Fremont National Forest in Oregon. The total area of infestations in the region was 209,280 acres, compared with the 315,440 of 1958.

Based on surveys of egg masses deposited by the 1959 moth population, defoliation in 1960 should be light except on the Fremont National Forest, where some increases are likely. High populations of egg parasites and predators may, however, have an important bearing on future trends. No aerial spraying was done in 1959 and none will be done in 1960.

New Locality Record For European Pine Shoot Moth

The European pine shoot moth, *Rhyacionia buoliana* (Schiff.), was reported for the first time in the Pacific Coast States in the spring of 1959 on ornamental red pine near Seattle, Washington. This insect, imported accidentally from Europe many years ago, is a serious pest of young pine plantings, nurseries, and ornamentals in the Northeastern, Central, and Lake States. Although the insect has been present on ornamentals in coastal British Columbia since 1927 without causing much damage, it may be a potential threat to ponderosa pine in both Oregon and Washington. Since the insect is apparently limited to western Washington, eradication is being considered.

Biological Control of Balsam Woolly Aphid Intensified

Damage to true firs by the balsam woolly aphid, *Chermes piceae* (Ratz.), decreased for the second successive year in Oregon and Washington, although aphid populations continued to increase in several areas (fig. 3). Subalpine fir stands in Oregon had many newly killed trees in late September, suggesting that heavy kills will again become a problem (fig. 4). In Washington, the largest centers of aphid infestations were on Pacific silver fir in and near the Gifford Pinchot National Forest. One new infestation center of light intensity developed in subalpine fir on the Yakima Indian Reservation, marking the easternmost known range of the aphid in Washington.

Biological control of the aphid was intensified during the year by colonizing additional foreign insect predators. Thirteen species of predators totaling 38,445 individuals were released in infested stands. Nine of these species had not previously been released in the Pacific Northwest.



Figure 3. Fir twigs gouted and killed by balsam woolly aphid.

Other Insects Cause Damage

The outbreak of a ponderosa pine needle miner, *Argyresthia* sp., discovered in 1958 on the Fremont National Forest, Oregon, increased in area and intensity. Feeding was conspicuous but damage to host trees was not severe. Defoliation of larch by the larch bud moth, *Zeiraphera griseana* (Hbn.), on the Colville Indian Reservation and on the Okanogan and Snoqualmie National Forests,

Washington, declined sharply. Infestations of the black-headed budworm, *Acleris variana* (Fern.), also dropped to low levels, continuing the decline of 1958.

Outbreaks of the spruce aphid, *Aphis abietina* Wlk., along the coast of Oregon caused light to moderate defoliation of spruce on and adjacent to the Siskiyou and Siuslaw National Forests. In the past this insect was blamed for extensive killing of Sitka spruce in Oregon and Washington before being con-



Figure 4. Heavy attack of balsam wooly aphid on bole of subalpine fir.

controlled by natural factors. Outbreaks in recent years, however, subsided without causing serious damage.

Defoliation and killing of ponderosa pine by the pine needle scale, *Phenacaspis pinifoliae* (Fitch), in the vicinity of fruit orchards in Oregon and Washington continued about the same as in 1958. The principal infestation centers noted in 1959 were in the Hood River Valley in Oregon and the lower Klickitat River drainage in Washington. This type of infestation--in the vicinity of orchards--has occurred during the past several years, and is attributed to a reduction in predators and parasites caused by spray drift from the orchards. This insect has not yet become sufficiently important to warrant control.

The infestation of pandora moth, *Coloradia pandora* Blake, discovered in stands of ponderosa pine west of Sisters, Oregon, in 1958, was controlled by predators and parasites. A similar decline occurred in infestations of the spruce bud moth, *Zeiraphera ratzeburgiana* Sax., in stands of Sitka spruce.

The Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD., was common on Douglas-fir and white fir in eastern

Oregon and indications are for higher populations in 1960. The fall webworm, *Hyphantria cunea* (Drury), was conspicuous on deciduous forest trees west of the Cascade Range in both States and was abundant on fruit, ornamental, and shade trees in many areas. Some parasitism of the full-grown larvae was reported, but since the webworm passes the winter in the pupal stage, the total impact of parasitism of the population was not determined.

The western tent caterpillar, *Malacosoma pluviale* (Dyar), was prevalent on red alder in western Oregon and Washington, but defoliation of trees was less severe than during the previous two years. An outbreak of an unidentified species of *Neodiprion* sawfly occurred on Douglas-fir in a small area southeast of Puyallup, Washington. The outbreak is expected to subside, however, because the larvae were heavily infected by a fungus disease. Other sawfly species caused minor defoliation of subalpine fir, grand fir, and western hemlock in the Cascade Range of both States.

The fir leaf roller, *Argyrotaenia dorsalana* (Dyar), increased in numbers on true fir trees in eastern Oregon in areas sprayed for spruce budworm control in 1958. Defoliation, however, was not severe and probably will cause no mortality in 1960. A spruce needle miner, *Recurvaria* sp., was reported from the Heppner Ranger District of the Umatilla National Forest in eastern Oregon, where an upward trend of infestations developed locally. The western willow leaf beetle, *Galerucella decora* Say, defoliated willows in extensive areas of Clatsop and Tillamook Counties in northwestern Oregon. An outbreak of the western oak looper, *Lambdina fiscellaria somniaria* (Hulst), in 1958 in the Willamette Valley collapsed in 1959 without causing measurable damage.

Cone And Seed Insects Important Pests

Insects attacking cones and seeds, particularly those of Douglas-fir and ponderosa pine, are important pests in Oregon and Washington nearly every year (fig. 5). On most areas in 1959, however, damage to Douglas-fir seed was less serious because the unusually heavy cone crop offset the losses from the insects. The Douglas-fir cone moth, *Barbara colfaxiana* Kearf., caused little damage and the Douglas-fir cone midge, *Contarinia oregonensis* Foote, caused significant loss of seed only in local areas (fig. 6). Damage to ponderosa pine cones by cone moths was high and the ponderosa

pine seed moth, *Laspeyresia piperana* (Kearf.), greatly reduced seed production in many areas.

California Tortoise-Shell Epidemic In Oregon

The California tortoise-shell, *Nymphalis*

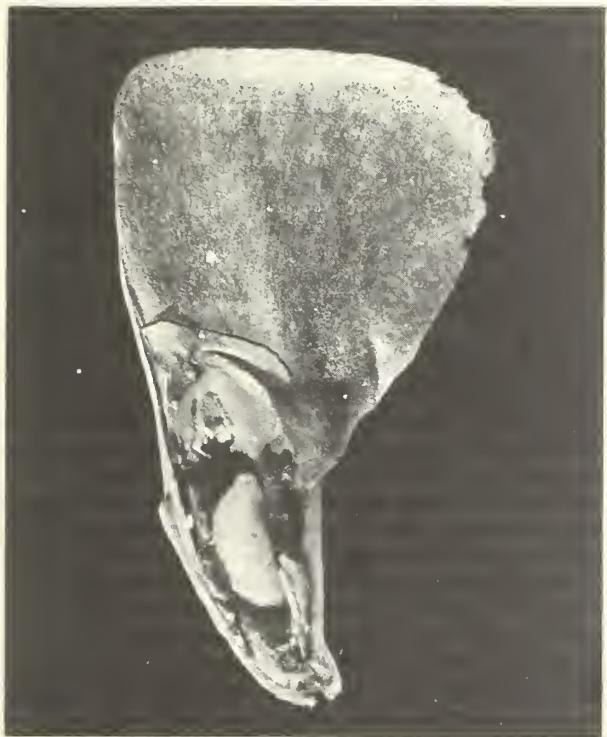


Figure 5. A seed chalcid, *Megastigmus* sp., in seed of noble fir.

Highlights

1. Timber losses caused by several species of bark beetles were the highest of any recent year. Tree-killing will probably increase in 1960.

2. Epidemic infestations of the lodgepole needle miner continued unabated at Yosemite National Park. Aerial spraying at Tuolumne Meadows suppressed populations and prevented tree-killing in this valued recreational area.

3. Widespread infestations of the black pine leaf scale developed in stands of sugar pine at several places in the state; damage in local areas was severe.

4. The density of spruce budworm populations increased in the Warner Mountains. If this situation continues, aerial spraying may be needed to protect the fir resources.

californica (Bdv.), was epidemic in 1959 on snowbrush at widely separated localities in Oregon. Severe defoliation was reported from the Deschutes, Willamette, and Fremont National Forests. Flights of the butterfly attracted much attention during late August and early September.

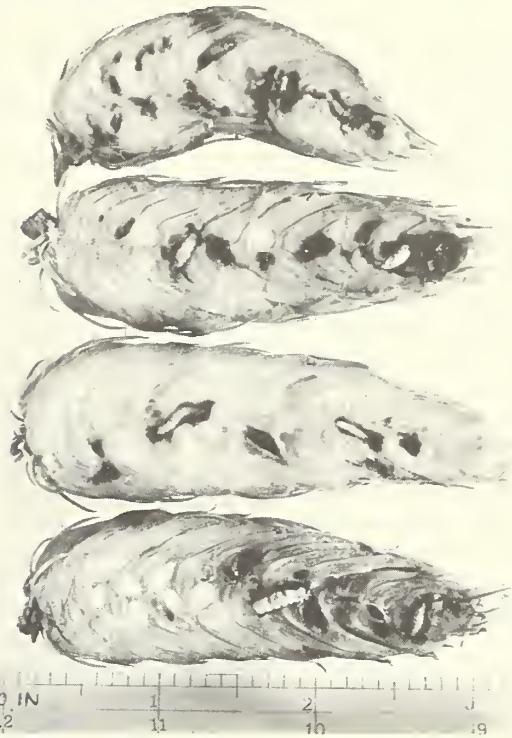


Figure 6. Damage to cones of Douglas-fir caused by the Douglas-fir cone moth, *Barbara colfaxiana* Kearf.

California

5. The sugar pine cone beetle destroyed a large percentage of the sugar pine cone crop; other cone and seed insects took toll of seeds of other conifers.

6. An incipient outbreak of the pandora moth was discovered in San Diego County--the first in the State for several years.

Outbreaks Of Western Pine Beetle Severe

After several years of low losses, the western pine beetle, *Dendroctonus brevicomis* Lec., developed many serious outbreaks in ponderosa and Coulter pine across California. One of the most serious was on the Sierra National Forest from 4,000 to 6,000 feet elevation, where groups of trees, sometimes including 20 or more, were attacked. In Siskiyou County, infestations increased on several thousand acres. Heavy group loss

also occurred on some 150,000 acres in parts of Shasta and Lassen Counties. In southern California, many Coulter pines were killed at several locations; in Riverside County, groups of 90 or more trees were killed late in the season.

In some places outbreaks were sparked by forest fires where beetle broods developed in scorched trees; in others they developed in trees struck by lightning. Warm, dry weather during winter and early spring favored beetle broods in all areas.

Mountain Pine Beetle Infestations Most Abundant In Decade

Infestations of the mountain pine beetle, *Dendroctonus monticolae* Hopk., in sugar pine were more numerous and widespread than at any time in the past 10 years. The beetles killed more lodgepole pine in many stands, and began new infestations in pole-size stands of ponderosa pine in Modoc County.

The most critical outbreaks in sugar pine were in the southern part of the westside Sierra in Calaveras, Mariposa, Madera, and Tuolumne Counties. In some places, trees of all ages were killed in groups. Mortality over large areas averaged one or more pines per quarter section. Several widespread outbreaks of lesser intensity also occurred in the northern part of the westside Sierra. Infestations covered several thousand acres in both Shasta and Yuba Counties. In Yosemite National Park, and in the adjacent Mather-Crane Creek drainages, losses are the highest in several years.

Infestations in lodgepole pine increased but became critical in only a few areas. The outbreak in the Dingley-Delaney Creek drainages near Tuolumne Meadows, Yosemite National Park doubled that of 1958, and a new loss center developed in the vicinity of Cathedral Lake where stands had been weakened by needle miner defoliation. Other centers of severe infestations in lodgepole pine occurred at Lassen Volcanic National Park, Lassen County; on the Plumas National Forest in Plumas County; and, in local areas in Siskiyou County east of Mount Shasta.

Mountain pine beetle outbreaks in stands of ponderosa pine were few and small. The insect infested pole-sized stands in the Warner Mountains of Modoc County, spreading to adjacent stands on the Fort Bidwell Indian Reservation.

Tree-Killing By Jeffrey Pine Beetle Increasing

The rate of tree-killing in stands of Jeffrey pine by the Jeffrey pine beetle,

Dendroctonus jeffreyi Hopk., showed signs of increasing in several parts of California. The outbreak, covering some 100,000 acres on the Cannell Meadows Working Circle, Sequoia National Forest, grew larger, and a new infestation developed on some 9,000 acres near Hessian Meadows on the Inyo National Forest. Other infestations were reported in Sierra, Shasta, and Lassen Counties and in the recreational areas around Lake Arrowhead and Big Bear Lake in San Bernardino County.

Populations Of Pine Engravers Up

The pine engraver beetles were active across the State, damaging and killing an increasing number of trees. Both the Oregon pine engraver, *Ips oregonis* (Eichh.), and the California five-spined engraver, *Ips confusus* (Lec.), top-killed mature pines in many areas and killed some smaller trees (fig. 7). Engraver beetles also were associated with many of the outbreaks of western pine beetle in ponderosa and Coulter pines and, to a lesser degree, the mountain pine beetle in sugar pine. Trees top-killed by the engravers now are subject to attack by *Dendroctonus* species, thus adding to the likelihood of increased losses. The pine engravers were particularly abundant at the following locations: Hat Creek drainage, Shasta County; Slate Creek drainage, Tahoma County; the Rockerby area, Yuba



Figure 7. Top-killing and tree-killing caused by *Ips* engravers in pine stands of California.

County; Dark Canyon, Sierra County; Bass Lake area, Madera County; and throughout the foothill country from Shasta County to Tulare County. Pine stands in southern California also were severely affected and, because infestations occurred in recreational areas, losses were especially serious.

Fir Engraver Increases In Numbers

Infestations of the fir engraver, *Scolytus ventralis* Lec., in red and white fir stands were spotty, but losses were heavier than in 1958. Near Bear Valley in Placer County, several thousand trees were killed, with the loss concentrated at two locations in Tulare County. The trend of infestations in all affected areas is not clear, but heavier losses can be expected in most susceptible stands in 1960.

New Outbreaks Of Douglas-Fir Beetle Localized

Losses in Douglas-fir caused by the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk., remained low throughout most of northwestern California, but spot outbreaks developed in parts of that area and the westside Sierra. Beetle activity in the Sierras revived, after many quiet years, in the Lost Creek drainage in Plumas County and near Green Burney in Shasta County. In the North Coast subregion, the most serious problem was in part of Humboldt County where heavy broods developed in windthrown trees.

Douglas-Fir Engraver Active

Activity of the Douglas-Fir engraver, *Scolytus unispinosus* Lec., was common in Sonoma, Mendocino, and Humboldt Counties in the late winter and spring. Drought and logging slash were probably the main factors contributing to increases of this insect. Some outbreaks are continuing. The size of the problem will be apparent only when currently infested trees begin to show evidence of infestation in the summer of 1960.

California Flatheaded Borer Active In Southern California

Tree-killing by the California flatheaded borer, *Melanophila californica* Van Dyke, was confined in large part to the forested areas in southern California. Although Jeffrey pine was the predominant host of the borer

in most affected areas, ponderosa and Coulter pines were also killed in many areas. Controls, wherever applied, lessened damage markedly from that of previous years.

Aerial Spraying Suppresses Pine Reproduction Weevil

The pine reproduction weevil, *Cylindrocoprus eatoni* Buch., was sufficiently destructive to young pine plantations in parts of the central Sierras to require aerial application of insecticides for suppression. Two plantations totaling 2,050 acres on the Stanislaus National Forest were sprayed with DDT late in May; two smaller areas on the Eldorado National Forest were treated early in June. Infestations in the extensive plantations in northeastern California were not severe, and no control action was taken.

Scale Insect Active

The black pine leaf scale, *Nuculaspis californica* Coleman, developed outbreaks in stands of sugar pine at several places during the year. The insect caused foliage yellowing in four of the national forests in the North Coast subregion, and two others in the central part of the State. In each of the locations, infestations occurred on several hundred to several thousand acres. The ultimate effects of the scale on the host trees are not now known, but damage is such that some of the land managers already have begun salvage of the more heavily infested trees.

Lodgepole Needle Miner Outbreak Continues In Yosemite

The lodgepole needle miner, *Recurvaria milleri* Busck, continued its outbreak in the high-elevation stands of lodgepole pine in Yosemite National Park. Trees on some 60,000 acres are in danger unless infestations subside or controls protect them in the near future. An additional smaller infestation covered about 1,300 acres in Sequoia-Kings Canyon National Park. A suspect area of infestation was detected near China Lake on the Sierra National Forest.

Spray protected high-value recreational forests in Yosemite National Park. The formulated spray, applied from helicopter at a rate of 2 pounds of malathion in 20 gallons of diesel fuel per acre, proved effective. The spraying was divided into two

parts: 800 acres were sprayed in July to kill the moths which were in flight at that time, and about 2,600 acres were sprayed in late August to kill the young larvae as they emerged from the eggs. The effectiveness of the spray directed at the moths was estimated at 90 percent; that directed at the larvae, about 70 percent.

Spruce Budworm Populations Increase In Warner Mountains

The spruce budworm, *Choristoneura fumiferana* (Clem.), is limited in its distribution in California to the Warner Mountains in Modoc County. In the North Warners, infestations have persisted in stands of White fir for many years without causing appreciable damage. During 1958, however, defoliation increased and, for the first time, infestations were found in the South Warners. In 1959, populations in both areas increased and defoliation was noticeable on 2,800 acres. If population densities remain heavy, it may be necessary to spray infested areas.

Cone And Seed Damage Severe

Several species of cone and seed insects caused serious damage throughout the State to seed crops that were already generally light. The sugar pine cone beetle, *Conophthorus lambertianae* Hopk., destroyed almost all of the sugar pine cones (fig. 8), and other species of the same genus severely damaged ponderosa and Jeffrey pine cones. Damage to the Douglas-fir seed crop was spotty, ranging from light in the western portion of the Douglas-fir region to very heavy in the eastern portion. Larvae of the cone moths, *Dioryctria abietella* (D.&S.) and *Barbara colfaxiana* Kearf, were responsible for most of the Douglas-fir cone damage. The Douglas-fir seed chalcid, *Megastigmus spermotrophus* Wachtl., damaged additional seed.

Miscellaneous Insects Take Their Toll

The Great Basin tent caterpillar, *Malacosoma fragile* (Stretch), defoliated woody browse plants on large areas on the Lassen, Tahoe,

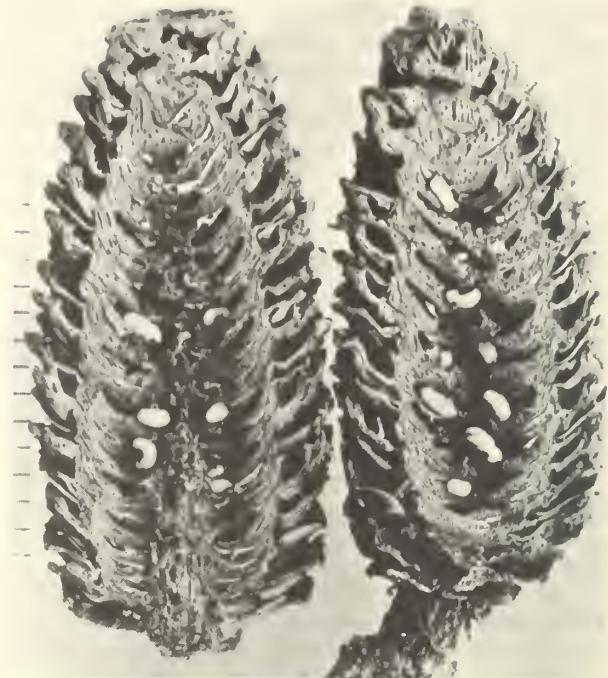


Figure 8. *Conophthorus* beetles destroy seeds in cones of sugar pine.

and Inyo National Forests. The California tortoise-shell butterfly, *Nymphalis californicus* Bdv., stripped foliage from ceanothus in parts of Humboldt County. Large populations of the silver-spotted tiger moth, *Halisidota argentata* Pack., were active in many parts of the State. The pandora moth, *Coloradia pandora* Blake, was observed in the Laguna Mountains and at Cuyamaca Rancho State Park in San Diego County.

Infestations of a *Chermes* species (probably *pinicorticis* Fitch), on white fir and Douglas-fir were widespread through the State, and the gouty pitch midge, *Retinodiplosis inopsis* (O.S.), was very abundant on parts of the Lassen and Klamath National Forests. The lodgepole terminal weevil, *Pissodes terminalis* Hopk., killed terminal of that pine from Shasta County to Inyo County. The Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD., epidemic in stands of white fir on the Stanislaus National Forest in 1956, was at a low level in 1959.

Intermountain Region

Highlights

1. The mountain pine beetle continued in outbreak in many parts of the region. Conditions were most severe in stands of lodgepole pine in Utah, Idaho, and Wyoming.

2. Serious infestations of the Engelmann spruce beetle occurred in the high-elevation spruce stands in Utah and Wyoming and in other spruce stands in Montana and north Idaho.

3. Approximately 4 million acres of spruce-fir timber in Montana and Idaho are infested by the spruce budworm. This includes parts of some areas sprayed several years ago.

4. A new outbreak of pandora moth covered approximately 15,000 acres of lodgepole pine forest in the Uinta Mountains of Utah.

5. Infestations of the lodgepole needle miner were widespread in Idaho, and caused severe damage.

Mountain Pine Beetle Infestations Widespread

The mountain pine beetle, *Dendroctonus monticola* Hopk., is a major pest of all the important pine species in the Intermountain Region. Severe infestations occurred in many areas. Stands of old-growth western white pine in Montana and north Idaho were heavily infested; the average rate of tree-killing was 1 to 5 percent of the green stands. Tree mortality in 1959 was about $2\frac{1}{2}$ percent of the stand volume on the Clearwater National Forest, and in other parts of Idaho and western Montana.

Mountain pine beetle infestations ranged from low endemic to highly epidemic in lodgepole pine stands. Several infestations in Montana and north Idaho were reported at low levels and one outbreak under observation for several years decreased 64 percent in 1959. In northern Utah, western Wyoming and southern Idaho, however, infestations were epidemic and severe tree-killing was widespread. In Idaho, epidemic infestations occurred on the Targhee and Sawtooth National Forests and on non-Federal lands near Kilgore. In Wyoming, epidemics were reported on the Teton National Forest and in Grand Teton National Park. An extensive outbreak on the Wasatch National Forest, Utah, continued and a new, threatening infestation developed on the Ashley National Forest. Major effort was made during the year to reduce the rate of tree-killing in all seriously affected areas and, although control measures were successful where applied, new outbreaks and the expansion of older ones indicate a continuing serious problem.

Second-growth ponderosa pine often is killed by the mountain pine beetle in dense, crowded stands. Two serious infestations in such stands occurred in the Intermountain Region. One, which started at the north end of Lake Tahoe in Nevada, in 1949, increased in scope and severity each year

until 1958. Then an estimated 6,000 infested trees were removed from the area in an effort to suppress the beetle. Control was not continued in 1959, however, and residual populations increased, killing an additional 8,000 trees. The second infestation was found on the Boise National Forest in Idaho in 1958, and approximately 1,500 infested trees were cut, decked, and burned. Currently, the rate of tree-killing in the latter area is low, with only 500 trees killed during 1959.

Engelmann Spruce Beetle Infestations Severe

The Engelmann spruce beetle, *Dendroctonus engelmanni* Hopk., is one of the most destructive insects in the Intermountain Region, and severe outbreaks have been common for many years. In the past decade, several widespread epidemics have occurred in north Idaho, Montana, and Utah. Vestiges of these infestations, as well as newly developed ones are causing serious depletion of the spruce stands. There are some indications that beetle activity is decreasing in most of the previously infested drainages in Montana and north Idaho. However, a serious infestation remains on the Kootenai National Forest, and will require suppression to prevent its spread. Serious infestations also continue in old outbreak areas in western Wyoming, and in the newer ones in northeastern Utah. On the Bridger National Forest in Wyoming, an epidemic in the vicinity of Gypsum Creek has been contained by logging, chemical treatment, and the use of trap trees. Woodpeckers and parasitic insects also helped to reduce beetle populations, but recent investigations point to the need of additional control to prevent flareups and spread in this area.

A large-scale outbreak developed in high-elevation spruce stands on the Uinta, Ashley, and Wasatch National Forests in 1958. An immediate program of suppression drastically reduced the beetle population. Nevertheless, the outbreak still continues and will probably kill even more trees in 1960. Natural agents controlled outbreaks in a 100-acre area on the Targhee National Forest and two centers on the Teton National Forest. Other outbreaks showed strong indications of increasing. Four of these at separate locations in Utah contained over 80,000 infested trees, and were considered potentially explosive.

Other Major Bark Beetles Cause Losses

Increases in the rate of tree-killing by the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk., were reported from several areas. Although centers of beetle activity were numerous in Montana, northern Idaho, and western Wyoming, there were no large outbreaks reported from any of these areas.

The western pine beetle, *Dendroctonus brevicomis* Lec., was apparently more active on the Lolo and Nezperce National Forests in Montana and Idaho than during the past few years. In general, attacked trees were few in number and widely scattered. Some, however, were in small groups, indicating a continuation of infestations in 1960. Engraver beetles were associated with pine beetle attack in several instances, especially in smaller trees.

More outbreaks of secondary bark beetles were reported from Montana and north Idaho during 1959, indicating increased activity. Many of the infestations were *Ips oregonis* (Eichh.) in ponderosa pine.

The fir engraver, *Scolytus ventralis* Lec., was epidemic in the Wheeler Peak Area on the Humboldt National Forest, Nevada. The insect also killed many trees in southern Utah.

Spruce Budworm Infestations Widespread

Epidemic infestations of the spruce budworm, *Choristoneura fumiferana* (Clem.), which have plagued Douglas-fir forests in central Montana and northern Idaho for the past 10 years, changed little during 1959. Most of the Douglas-fir type east of the Continental Divide in Montana is infested to some degree, and much of the acreage sprayed to suppress populations in prior years is repopulated to varying degrees. West of the divide, tree damage from defoliation is not severe with a single exception; in the Craig Mountain area south of Lewiston, Idaho, the budworm has persisted in mixed stands of Douglas-fir and grand fir for at least 10 years, killing mature trees and those in the understory. The scope and severity of spruce budworm infestations in Montana and northern Idaho is indicated by the following data:

	<u>Acres</u>
Infested during period 1947 - 1959.....	5,888,000
Sprayed with insecticide, 1953 and 1955-57	2,169,000
Resprayed during period, cumulative total	163,500
Controlled by natural agents.....	276,000
Infested in 1959.....	3,442,950

In southern Idaho, budworm infestations increased in scope and intensity from 1952 to 1957. During this time, approximately 2,030,000 acres were treated with aerial spray. No spraying was done in 1958 or 1959 and, with minor exceptions, all remaining infestations are considered to be static or decreasing. Infestations in 1959 occurred on 499,000 acres of the Payette, Salmon, Sawtooth, and Targhee National Forests. Of this total, only 59,000 acres were heavily damaged.

On the Salmon National Forest, a change in the pattern of infestation was noted in 1959; for the first time in 5 years defoliation occurred in small broken areas rather than in large continuous blocks. No new infestation centers were discovered and defoliation was severe on only 10,000 of a total of 165,000 acres. A decrease in severity of infestations is predicted for 1960.

On the Sawtooth National Forest, large fluctuations in the density of budworm populations have occurred from year to year since 1949. A strong rise in 1957 was followed by a definite decrease in 1958. The trend was upward again in 1959, and severe defoliation is probably in store for 1960.

Infestations on the Targhee National Forest were first discovered in 1956 and populations in seriously affected areas were suppressed by aerial spraying in 1957. Although some reinfestation occurred in sprayed areas in 1958, defoliation was not severe; in 1959 only 4,000 of a total of 204,000 acres were heavily damaged. Parasites and predators will probably cause a downturn in the infestation in 1960. Although considerable budworm damage has occurred on the Payette National Forest during the past few years, only 5,000 acres are now known to be infested.

In general, spruce budworm infestations in southern Idaho were relatively less serious than in past years. High populations in some areas could intensify and spread, but are not expected to do so in 1960.

Sawflies In Outbreak Status

Several outbreaks of sawflies occurred in the coniferous forests of the Intermountain Region during the year; at least six different species have been taken from various hosts. An undescribed *Neodiprion* species severely defoliated lodgepole and ponderosa pine in and adjacent to the Lewis and Clark National Forest in Montana. *N. burkei* Midd. stripped almost all old-growth needles from

lodgepole pine on some 5,000 acres near Cascade Reservoir in Idaho. Both of these infestations will probably moderate in 1960. A species of the *N. abietis* complex, known before only from the Craters of the Moon National Monument in Idaho, appeared in outbreak numbers in 1959 on the Sawtooth National Forest and in Owyhee County.

An unknown species of sawfly infesting pinyon pine was discovered for the first time in 1959 on a 75-square-mile area near Pioche, Nevada. This outbreak apparently started a few years ago in Hulse Canyon, where some 90 percent of the trees now are dead. Pinyon pines are not valuable for timber, but many are used for Christmas trees.

The larch sawfly, *Pristiphora erichsonii* (Htg.), a major forest insect in the Eastern States, was discovered in 1958 near Missoula, Montana, for the first time since 1944. Defoliation in 1959 was noted only in large patches of western larch in the Blackfoot River drainage near Missoula. To what extent infestations occur elsewhere in Montana is not known. Two other *Pristiphora* species, both as yet undescribed, were reared in 1959 from western larch near Sandpoint, Idaho.

Pine Butterfly A Potential Threat

At periodic intervals, the pine butterfly, *Neophasia menapia* (F. & F.) erupts in epidemic numbers in the Intermountain Region and poses a severe threat to valuable stands of ponderosa pine. Because of this, a close watch of forest stands is kept to detect the first signs of increasing populations. During 1959, this butterfly was numerous in parts of northern Idaho and western Montana. Though adults were observed hovering near the tops of tall trees on the Nezperce and Clearwater National Forests, there was no indication of localized outbreak centers. Continued surveillance is planned.

Larch Casebearer New To Region

The larch casebearer, *Coleophora lanicella* (Hbn.), a recent introduction in the Intermountain Region, is now known to occur throughout most of northern Idaho and northeastern Washington. In 1959, the insect ranged northwest as far as Colville, Washington, north to Bonners Ferry, Idaho, east to the Idaho-Montana boundary, and south to Bovill, Idaho. This range, encompassing 8,000 square miles, is twice the area of infestation known in 1958. In contrast to the

rate of spread, severity of infestations in 1959 changed but little and defoliation was visible on only 20,000 acres. Samples indicate that less than 1 percent of the population was parasitized in 1959 and by only one species, a wasp, *Spilochalcis albifrons* (Walsh). Control by natural agents is doubtful unless additional parasites are introduced.

Tussock Moths--A Continuing Problem

Several outbreaks of tussock moths occurred in the Intermountain Region during the past several years. The many different host species attacked, suggest that more than one species of moth may be involved. The Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD., is known to be the species that erupted in Owyhee County, Idaho, in 1957. This infestation, on some 5,000 acres, was controlled by a virus in 1958. Only one small spot infestation was found in the general area in 1959. However, the same species may be involved in an epidemic discovered on about 5,000 acres of white fir on the east side of the Snake Range, Humboldt National Forest, Nevada, in the late fall. The insect probably has been active in this area for about 5 years, and conditions indicate an increase in scope and severity of defoliation in 1960. Three other outbreaks of the same or a closely related species also were reported in the Intermountain Region. One of these, in the vicinity of Carson City, Nevada, occurred on bitterbrush and persisted for two or more years, often killing twigs, but not causing much mortality to the browse plant. Another outbreak, near Idaho City, Idaho, covers some 10,000 acres of ceanothus, willow, ninebark, ribes, and rosebrush. A virus disease practically eliminated the entire infestation during this first year of defoliation.

On the Targhee National Forest, a tussock moth was found for the first time in 1959 feeding on dwarfmistletoe on lodgepole pine. This unusual sort of larval feeding could prevent seed formation and consequently be beneficial in reducing mistletoe spread.

New Outbreak of Pandora Moth In Utah

In mid-June, an outbreak of the pandora moth, *Coloradria pandora* Blake, ranged across 15,000 acres of lodgepole pine forests near the Summit Springs Ranger Station in the Uinta Mountains, Ashley National Forest, Utah. At the time of discovery, caterpillars

were mature, indicating that the infestation first occurred in the area in 1958 or earlier. Trees on approximately 300 acres were severely defoliated; about 1 percent of them were completely stripped. Inspection of broods during the summer and later in the year revealed that only small percentages of larvae and pupae were parasitized or diseased and there was no evidence of predation by small mammals. The course of the outbreak cannot be predicted, but since the young larvae will inflict only minor damage on host trees in 1960, suppression can wait until 1961.

Lodgepole Needle Miner A Potential Threat

The lodgepole needle miner, *Recurvaria milleri* Busck, is an important enemy of lodgepole pine in the Intermountain Region. Currently an outbreak exists on approximately 104,000 acres on the Cassia division of the Sawtooth National Forest and on the Targhee National Forest in Idaho. Although the infestation has been in this area for 2 years, there has been no tree-killing to date and none is expected in 1960. Populations will undoubtedly continue to increase for the next few years, and damage may become severe in the future.

Other Insects Cause Defoliation and Stunt Growth

Several other species of forest insects occurred in abundance in the Intermountain Region during 1959. The aspen leaf miner, *Phyllocnistis populiella* Chamb., a serious defoliator in western Wyoming and southeastern Idaho in the past decade, was widespread. Repeated defoliation caused patch-killing of aspen in several locations. Further, stands over large areas have been so weakened that trees currently are producing only stunted foliage, and additional tree mortality is expected.

The alder fleab beetle, *Altica ambiens* (Lec.), occurred over large areas of streamside cover in northern Idaho and northwestern Montana.

Defoliation of lodgepole and whitebark pine by a pine-feeding budworm, *Choristoneura* sp., was noticeable in eastern Montana, in Yellowstone National Park in Wyoming, and in stands of ponderosa pine near Helena, Montana. In all areas, infestations were associated with the spruce budworm in adjacent or intermixed stands of Douglas-fir.

The Engelmann spruce weevil, *Pissodes engelmanni* Hopk., was abundant in the Kishenehn Creek drainage in Glacier National Park, where persistence of infestations caused severe stunting. A gouty pitch midge, *Retinodiplosis* sp., was active in many parts of the region during the year. Lateral branch tips of pines on several thousand acres of plantations on the Kaniksu National Forest in Idaho were damaged. A pine tip-moth, *Rhyacionia* sp., has persisted for many years on the Long Pine and Sioux divisions of the Custer National Forest in Montana, and successive damage to terminals stunted and deformed large numbers of young ponderosa pines.

Epidemic populations of tent caterpillars, presumably *Malacosoma fragile* (Stretch), hit cottonwoods along all creek bottoms in the Wheeler Peak area, Humboldt National Forest, Nevada. Spot infestations of an undetermined scale insect infested pinyon pine in scattered places in the same areas.

Mealybugs, Aphids, And Mites Reduce Tree Vigor

Outbreaks of several species of sucking insects weakened trees of coniferous forests throughout the region. A spruce mealybug, *Puto* sp., in outbreaks in stands of Engelmann spruce in southern Utah for the past several years, remained active in 1959. It now is prevalent on some 60,000 acres at three separate locations on the Fishlake and Dixie National Forests. The persistence of the mealybug for long periods causes deformity to trees, kills off reproduction, and reduces the vigor of overstory trees. An outbreak of another mealybug (species unknown), found in stands of true firs north of Hazard Lake on the Payette National Forest in Idaho in 1958, collapsed in 1959 before damaging the infested trees. A new infestation of the same species was found 10 miles west of Hazard Lake during the summer.

The Cooley spruce gall aphid, *Ceremes cooleyi* Gill., occurred in large numbers on ornamental spruce, Engelmann spruce, and Douglas-fir trees throughout Montana and northern Idaho. At some locations, infestations caused severe yellowing of needles. None, however, caused tree mortality or an appreciable killing of twigs and branches. A fir aphid, *Cinara* sp., was unusually abundant throughout grand fir stands in northern Idaho and on parts of the Kootenai National Forest in Montana. A woolly aphid, species unknown, was reported abundant on alpine fir east of the Continental Divide.

Infestations of the spruce spider mite, *Oligonychus ununguis* (Jac.), in Montana and northern Idaho lessened in scope and severity, but damaged trees at scattered locations on the Deerlodge, Lewis and Clark, Helena, and Gallatin National Forests in Montana, and in Yellowstone National Park. Although mite populations were low in these areas, damage to stands from the outbreaks of prior years is clearly visible.

Suppression Effective Against Black Hills Beetle

Infestations of the Black Hills beetle, *Dendroctonus ponderosae* Hopk., on the Dixie Na-

tional Forest and at Bryce Canyon National Park in southern Utah were much reduced from levels of prior years. Sustained control efforts were primarily responsible. The downward trend of infestations first reported in 1958 continued in 1959. The severe drought in 1959 may, however, bring back high populations unless suppressive controls are continued. Some 2,200 infested trees on the national forest and about 200 in the national park require treatment during 1960 to prevent an upsurge of populations and increased tree-killing. Another infestation was reported late in the year at Wheeler Peak on the Humboldt National Forest in Nevada.

Central and Southern Rocky Mountains

Highlights

1. Spruce budworm infestations in southern Colorado and northern New Mexico expanded to cover more than 1 million acres. Increases in scope and severity are indicated for 1960.

2. The Engelmann spruce beetle continued to be a serious problem in spruce stands adjacent to timber sales in southern Colorado and at one location in northern New Mexico. Large numbers of beetles in cull material may cause new outbreaks.

3. A new outbreak of pandora moth was discovered in stands of lodgepole pine along the Colorado-Wyoming boundary.

4. Infestations of the Black Hills beetle increased greatly in stands of ponderosa pine in north-central Wyoming and along the Front Range in Colorado.

5. Additional defoliation by the Douglas-fir tussock moth and the New Mexico fir looper was prevented by timely suppression in outbreak areas in New Mexico and Arizona.

Spruce Budworm Epidemic

Infestations of the spruce budworm, *Choristoneura fumiferana* (Clem.). more than doubled in size in stands of Douglas-fir and true fir in southern Colorado, northern New Mexico, and Arizona. The acreages affected in 1959 by degree of defoliation are as follows:

	Light (acres)	Moderate (acres)	Heavy (acres)
Colorado.....	208,860	133,480	7,260
New Mexico.....	469,580	124,260	25,440
Navajo Indian Reservation, Ariz.....	50,500	29,600	3,200

In Colorado outbreaks are most serious on the Pike, Rio Grande, and San Juan National Forests and adjacent private lands. Incipient infestations were found on the Uncompahgre and Routt National Forests. The infestation on the Pike Forest was first observed in 1958; damage to trees, except in small localized areas, has been light. Infestations have persisted on the Rio Grande National Forest for about 16 years. Moderate to heavy defoliation has occurred every year since 1954, killing many trees in both the understory and overstory. Outbreaks on the San Juan National Forest are extensive. Top-killing and scattered tree-killing are noticeable throughout the fir type on the eastern edge of the forest. Greater damage is expected in 1960.

Low parasitism of the budworm in southern Colorado and the increase in the number of egg masses deposited by the 1959 flight of the moth indicate a continued uptrend in populations.

The spruce budworm caused heavy defoliation in the fir type on the Carson and Santa Fe National Forests and adjacent private lands in New Mexico, and on the Navajo Indian Reservation in Arizona. Investigations in these areas point to a further increase in populations in 1960.

Black Hills Beetle Destructive

The Black Hills beetle, *Dendroctonus ponderosae* Hopk., increased throughout the ponderosa pine type in the Bighorn Mountains of Wyoming and the Front Range of Colorado. Epidemics exist on private lands west and northwest of Denver, Colorado. The outbreak in the Black Hills of South Dakota is

being controlled with chemicals. In northern New Mexico, infestations are decreasing. The beetle was found attacking limber pine in the San Mateo Mountains in central New Mexico in 1959--the first time the insect was reported that far south.

Logging Stimulates Spruce Beetle Activity

Several outbreaks of the Engelmann spruce beetle, *Dendroctonus engelmanni* Hopk., in the spruce forests of Colorado and New Mexico resulted from a buildup of beetle populations in cull material in logged areas (fig. 9). The beetles attack and develop in the shaded and under sides of cull logs where they are protected from enemies and the cold of winter by the deep snow. One or two years after logging, broods mature and emerge to attack nearby standing trees.



Figure 9. The helicopter is useful in surveying for Engelmann spruce beetle outbreaks at high elevations in central Rocky Mountains.

The more important infestations in Colorado were on the Uncompahgre and San Juan National Forests, where over 21,000 trees were killed around logging areas. Many beetles also inhabit cull logs on 45 separate timber-sales areas on these and other national forests in southern Colorado, and will be a threat to trees after emergence next June.

In New Mexico, the spruce beetle was reported in outbreak only in one area, near Chama. Probably this infestation also developed in logging slash.

Less Pine Bark Beetle Damage In Arizona and New Mexico

Mortality of ponderosa pine throughout Arizona and New Mexico caused by the

complex of *Dendroctonus* and *Ips* beetles continued to decline in 1959. *Ips* beetles, usually *I. ponderosae* Sw., often start the attack in the top section of the trees; then *D. barberi* Hopk., *D. convexifrons* Hopk., and *D. parallelocollis* Chap., kill the lower sections. Concentrations of dead trees were seen only on part of the Lincoln National Forest in New Mexico and on the San Carlos Indian Reservation in Arizona.

Other Bark Beetles Cause Significant Losses

Other bark beetles, destructive to coniferous stands in the central and southern Rocky Mountains, were in outbreak only in small areas. The fir engraver, *Scolytus ventralis* Lec., increased on the Lincoln National Forest and the Mescalero Indian Reservation in southern New Mexico. An outbreak of long standing continued unabated in the Sandia Mountains east of Albuquerque. The Arizona five-spined engraver, *Ips lecontei* Sw., was abundant in second-growth stands of ponderosa pine near Prescott, Arizona. The mountain pine beetle, *Dendroctonus monticolae* Hopk., increased in stands of limber pine on the Shoshone National Forest in Wyoming.

Intensity of Douglas-fir Beetle Infestations Variable

Outbreaks of the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk., were reported from many areas in the central and southern Rocky Mountains. The total affected area of the Pike, Rio Grande, Roosevelt, San Isabel, and San Juan National Forests in Colorado and the Medicine Bow National Forest in Wyoming lessened in 1958. Areas of activity increased on the Shoshone National Forest and in the South Bighorn Mountains in Wyoming. In New Mexico, tree-killing was heaviest on parts of the Santa Fe and Coronado National Forests, being greater than in 1958.

Fir Tussock Moth and Looper Outbreaks Suppressed

Outbreaks of Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD., in 1958 at four locations in New Mexico and Arizona were controlled by aerial spraying in 1959. Except for a small infestation in the Sandia Mountains east of Albuquerque, populations were suppressed effectively. An outbreak of the New Mexico fir looper, *Galenara consimilis* Hein., occurred on an area of 1,500 acres on the Lincoln National Forest in New Mexico. This was the first recur-

rence of this major pest since 1952. Aerial spraying to suppress the tussock moth in the same area was also successful in reducing looper populations.

Outbreaks of Tent Caterpillars Subside From Natural Causes

Infestations of the Great Basin tent caterpillar, *Malacosoma fragile* (Stretch), have been widespread in southern Colorado and northern New Mexico for the past 10 years, and repeated defoliation killed many aspens. In 1959, natural factors drastically reduced populations over wide areas.

Pandora Moth Outbreak Discovered in Wyoming and Colorado

The *pandora* moth, *Coloradia pandora* Blake, caused light to heavy defoliation of lodgepole pine on approximately 9,000 acres of the Medicine Bow and Routt National Forests near the Wyoming-Colorado boundary. Overwintering pupae, abundant in the soil will probably produce a heavy moth flight in the summer of 1960. Because the insect has a two-year life cycle, damage by the young larvae in 1960 is not expected to be severe.

Lake States and Central States

Highlights

1. The spruce budworm defoliated increasingly more trees over a wider area in Minnesota, and moderate to serious infestations now exist on over 1 million acres in the northern part of the State.

2. The jack pine budworm severely defoliated its host in localized areas in Wisconsin, Michigan, and Minnesota.

3. Sawflies, shoot moths, pine weevils, hardwood defoliators, and other miscellaneous insect pests continued destruction in many areas.

Spruce Budworm Infestation Trend Upward

Infestations of the spruce budworm, *Choristoneura fumiferana* (Clem.), increased in area and intensity in spruce-fir stands in Minnesota, where more than a million acres were noticeably defoliated. The insect was active in northern Wisconsin and the Upper Michigan Peninsula, but most stands in these two States are young and vigorous, so the total damage should be small.

The severity of infestations in Minnesota prompted public and private agencies to start programs for suppression in areas of high commercial and recreational value. Using aircraft, workers sprayed a 7,240-acre area east of International Falls, and about 400 acres in the vicinity of Caribou Lake. Plans for a stepup of suppression in 1960 include spraying some 20,000 acres of commercial timber and about 300 acres of recreational lands.

The jack-pine budworm, *Choristoneura pinus* Free., has been an important pest of jack pine and of understory white and red pine in the Lake States for the past 30 years. Defoliation in 1959 was much heavier in

several areas in Wisconsin, Michigan, and Minnesota, but infestations were not widespread. In the vicinity of Cass Lake, Minnesota, some 600 acres were sprayed to reduce epidemic populations and prevent severe stripping of affected trees. Sampling in the summer and fall showed only 500 acres in the Chippewa National Forest, Minnesota, requiring control in 1960.

Defoliation Severe in Tamarack Stands

The larch sawfly, *Pristiphora erichsonii* (Htg.), has been epidemic in the Lake States since 1949 and partial to complete defoliation has occurred each year throughout the 482,000 acres of tamarack type in northern Minnesota. Defoliation in 1959 was general on about 350,000 acres in the north-central and northeastern sections of the State, and some tree mortality occurred on both the better sites and the thin soil sites. Infestations also increased in severity in northern Wisconsin and Upper Michigan and tree mortality in these areas may be expected in 2 to 3 years. Parasites exerted only a minor degree of control on sawflies because the host encapsulates the egg of its principal parasite, *Mesoleius tenthredinis* Morley.

Pine Sawflies Defoliate Plantings and Commercial Stands

Several species of pine sawflies damaged natural pine stands and plantations throughout the Lake States and the Central States. Scattered infestations of the red-headed pine sawfly, *Neodiprion lecontei* (Fitch), occurred in Michigan, Missouri, and south and west-central Ohio on red, Scotch, shortleaf, and pitch pines. Small areas in the Upper Michigan National Forest and in the southern part of the State had to be sprayed. The Saratoga spittlebug, *Aphrophora saratogensis*

(Fitch), required control on about 500 acres in southern Michigan, so treatment for both species was performed in one operation.

The area of defoliation of red, Scotch, and Austrian pines by the European pine sawfly, *Neodiprion sertifer* (Geoff.), in Ohio and Indiana doubled in 1959, but most infestations were light to moderate. In the Mohican State Park, Ohio, a 40-acre plantation of 6-year-old Scotch pine was completely defoliated, but nearby plantations escaped injury apparently because they were sprayed with a virus during outbreaks in 1953 and 1955. Plots similarly treated in the Henderson State Park, Illinois, also remained relatively free of attack and the virus was still active in the small population left in 1959. The introduced pine sawfly, *Diprion similis* (Htg.), again stripped white pine in scattered areas throughout Crow Wing County in Minnesota. It also fed upon jack pine, which was unusual. Feeding by the white-pine sawfly, *N. pinetum* (Nort.), in Ohio was generally light and scattered, but there were instances of pine mortality from severe defoliation.

A spring defoliator of shortleaf pine, *Neodiprion taedae linearis* Ross, first reported in the Central States in 1956, is now dispersed over most of southeastern Missouri and southern Illinois. Populations declined in natural shortleaf stands in 1957 and almost disappeared in 1958. In 1959, however, the insect became more widespread in southeastern Missouri. This species also lives in the South, where in some years it has been an important defoliator of loblolly pine in southern Arkansas and northern Louisiana.

Small light infestations of the jack-pine sawfly, *N. americanus banksiana* Roh., Swaine's jack-pine sawfly, *N. swainei* Midd., and the red-pine sawfly, *N. nanulus* Schedl, were reported in the Lake States.

Pine Weevils Destructive in Many Areas

The pine-root collar weevil, *Hylobius radicis* Buch., has become a serious pest of sapling-size jack and Scotch pines, and to a lesser extent red pine, in Wisconsin, Michigan, and Minnesota. Heaviest damage in 1959 was reported from northern Wisconsin, where complete girdling by weevil larvae killed many trees, and strong winds toppled others that were partially girdled.

The pale weevil, *Hylobius pales* (Hbst.), *Pissodes approximatus* Hopk., and *H. warreni* Wood, girdled seedlings in many Christmas

tree plantations in Wisconsin and Minnesota where broods developed in stumps left from cutting. If seedlings are planted within a year after the Christmas trees are harvested, conditions become ideal for weevils. Bark chewing on boles, leaders, and branches of Douglas-fir and pines up to 10 years old resulted in high mortality in some plantations. Stumps and slash should be removed to make conditions less attractive to the weevils and prevent development of damaging populations.

The white-pine weevil, *Pissodes strobi* (Peck) damaged leaders on pine and spruce in stands throughout the Lake States. Injury to red pine, particularly in northeastern Wisconsin, was common. Incidence of attack in red pine plantations increased, and Scotch and Austrian pine and Norway spruce were also attacked. Aerial and hand spraying of small infestations in many areas gave poor results. The reason for these failures was not apparent. In contrast, a small-scale test with lindane and aroclor, made by the Wisconsin Conservation Department, proved successful.

Shoot Moths and Tip Moths A Recurring Problem

Several species of shoot moths and tip moths caused severe damage to pine plantations in the Lake States and Central States (fig. 10). The European pine shoot moth, *Rhyacionia buoliana* (Schiff.), caused great



Figure 10. Repeated attacks by the European pine shoot moth make pines bushy and malformed.

damage to young red pine plantations, and more limited damage to Scotch pine plantations in Lower Michigan and in several localities in the Upper Peninsula and in Wisconsin.

The Zimmerman pine moth, *Dioryctria zimmermani* (Grote), continued to be an important pest of pines in Christmas tree plantings in Michigan, Wisconsin, and Indiana. It was also active in northeastern Illinois. Heaviest damage occurred near LaPorte, Indiana, where a 10-acre plantation of 8-year-old pines was so severely attacked that it had to be destroyed. Some plantation owners successfully reduced populations by spraying with DDT.

Twig killing of pines by the Nantucket pine moth, *R. frustrana* (Comst.), and a closely related species, *R. rigidana* (Fern.), has been noticeable for the past 18 months in the Northern Plains and in most of the Central States. In central Kentucky over 90 percent of the shoots in some plantations were infested. Examinations in plantations near Gambellsville, Kentucky, and Gledening Reservoir, Ohio, showed that at least 70 percent of the larvae were parasitized or diseased. Loblolly and shortleaf pines were more frequently infested than red, Scotch, pitch, or Virginia pines.

Saratoga Spittlebug Destructive in Wisconsin and Michigan

The Saratoga spittlebug, *Aphrophora saratogensis* (Fitch), one of the most serious pests of red pine and jack pine plantations in Wisconsin and Michigan, continued in several areas in 1959. Damage was especially severe in Wisconsin. Extremely hot, dry weather during the early summer in lower Michigan killed much of the population. Suppression during the year was undertaken on 4,100 acres.

The pine spittlebug, *A. parallela* (Say), also was reported from the Lake States. All pines are subject to attack by this insect, but damage during 1959 was most severe in areas planted to Scotch pine.

Pine Needle Miner Declines In Ohio

From 1954 to 1958, the pine needle miner, *Exoteleia pinifoliella* (Chamb.), caused severe browning of pitch pine foliage in Tuscarawas, Carroll, and Harrison Counties, Ohio. This year a reduced population did little or no damage in previously affected areas.

Turpentine Beetles Attack Seed Trees

The black turpentine beetle, *Dendroctonus terebrans* (Oliv.), was active in logging areas in the southern portion of the Cumberland National Forest, Kentucky. Residual seed trees were heavily damaged where scarification treatments were made by bulldozer to encourage pine regeneration. The beetle also attacked shortleaf pine at Eminence, Missouri, and in McCreary County, Kentucky, where trees were weakened by disease. Red pine in the Mohican State Forest, Ohio, suffered damage where cut material and stumps supported heavy beetle populations.

Mound Ants Kill Trees With Formic Acid

The Allegheny mound ant, *Formica exsectoides* Forel, killed young white pine in localized spots in Hardin, Holmes, and Coshocton Counties, Ohio. In these areas, there were as many as 10 mounds per acre and 3 to 10 year-old pines were killed in groups of 5 to 20. The ants destroy all vegetation around each mound for a distance of 20 feet or more by injecting formic acid into the tissues of the main stem. The ants are not vegetarians, and apparently kill trees to eliminate shade.

Hardwood Defoliators Abundant in Some Localities

Localized infestations of the gypsy moth, *Lymantria dispar* (L.), were again found in Michigan; 20,000 acres at three different locations were sprayed in a continuing eradication program. A followup failed to trap any moths in the treated areas, but moths were trapped at locations west and southwest of Lansing. An estimated 10,000 acres will be treated in 1960.

Large populations of forest tent caterpillar, *Malacosoma disstria* Hbn., dwindled to almost nothing in Minnesota and northwestern Wisconsin; adverse weather and parasitism were probably responsible. Larvae, hatching 10-14 days before the opening of the aspen buds, were hit by cold rains and high winds that helped destroy the starving caterpillars. The eastern tent caterpillar, *M. americanum* (F.), caused moderate to complete defoliation of black cherry, hawthorn, oak, willow, and cottonwood in eastern Ohio. Reports indicate that the insect is increasing and spreading westward. Tents of the fall webworm, *Hyphantria cunea* (Drury), were common on deciduous trees in Ohio, but feeding was

generally light except in Lake County where willow was severely attacked. Defoliation by the mimosa webworm, *Homadaula albizziae* Clarke, was moderate to complete on honeylocust throughout southern Indiana, central and southern Kentucky, and southwestern Ohio. The locust leaf miner, *Chalepus dorsalis* Thunb., damaged black locust in eastern Kentucky and in localized areas in southern Ohio and Decatur and Rush Counties, Indiana.

The walking stick, *Diapheromera femorata* (Say), defoliated oaks in Minnesota and Wisconsin and black locust and elm in Muskingum County and adjacent counties in Ohio. DDT spray was applied by aircraft to 350 acres on the Menominee Indian Reservation, Wisconsin, to suppress populations and prevent further weakening of the stands.

Locust Borer and Elm Bark Beetle De- structive

The locust borer, *Megacyllene robiniae* (Forst.) remained important throughout the Central States. It is especially harmful in strip-mining areas where black locust has been planted to reclaim land and stop erosion. Populations of the smaller European elm bark beetle, *Scolytus multistriatus* (Marsh.) were high in the Central States. This beetle carries the dreaded Dutch elm disease and wilting elms were a common sight in many woodlots in central and northeastern Ohio where the disease had been carried.

Hemlock and Poplar Borers Important Pests in Lake States

The hemlock borer, *Melanophila fulvoguttata* (Harr.), and the poplar borer, *Saperda calcarata* Say, caused damage in the Lake States in past years, and infestations were again reported from several areas in 1959. Several other borers, such as *Dicerca tenebrica* (Kby.), *Agrilus liragus* (B. & B.), and the gall-forming twig borer, *Saperda concolor* Lec., were common in stands of aspen in Michigan, Wisconsin and Minnesota. The bronze birch borer, *Agrilus anxius* Gory, and the bronze poplar borer, *A. Liragus* (B. & B.), also were reported in the Lake States, particularly in stands weakened by heavy cutting, wind-throw, and successive heavy defoliation. The sugar-maple borer, *Glycobius speciosus* (Say), occurred in localized areas and attacked smaller trees and the branches of larger ones.

Scales and Aphids Not Abundant

The pine tortoise scale, *Toumeyella numismatum* (P.&M.) develops epidemics on jack pine and Scotch pine in the Lake States, but it was not abundant during 1959. Although infestations occurred at several locations, populations were held in check by natural controls. The woolly pine aphid, *Pineus pinifoliae* (Fitch) killed and damaged some trees on the Superior National Forest, but was not widespread. The eastern spruce gall aphid, *Chermes abietis* L., caused light damage to white spruce and Norway spruce in Christmas tree plantations in local areas.

South and Southeast

Highlights

1. A severe outbreak of southern pine beetle developed in the Big Thicket area of east Texas in the summer and fall. Infestations also increased in parts of North and South Carolina.

2. The black turpentine beetle was destructive in many logging areas in the Gulf States; however, infestations were less severe in the Southeast than for the past several years.

3. The balsam woolly aphid continued in outbreak in stands of Fraser fir in North Carolina, killing many trees in high-value recreational areas at Mt. Mitchell.

4. Spider mites developed to epidemic numbers on an estimated 10 million acres

of pine forests in northern Louisiana and southern Arkansas.

5. The scope of elm spanworm infestations increased in the mountains of Georgia, Tennessee, and North Carolina, but the intensity of defoliation dropped from that of prior years.

6. The Virginia pine sawfly not only intensified defoliation activity in central Virginia and northeastern North Carolina, but spread southward.

Southern Pine Beetle Again Threatens Stands In East Texas

During early summer, an outbreak of the southern pine beetle, *Dendroctonus frontalis* Zimm., developed rapidly in the Big Thicket

of southeast Texas. The outbreak area, extending over 70,000 acres in Hardin and Liberty Counties, contained some 117 spot infestations with as many as 100 trees per spot. Suppression was promptly begun in the affected areas, but late summer and fall rains brought efforts to a halt as much of the country became inaccessible. As a result, 14 spots were uncontrolled at the year's end and beetles began to spread to scattered single trees over large areas. From these overwintering brood trees, new spot infestations will likely develop and even more serious problems will probably arise in 1960.

During the fall, the southern pine beetle was more active in Tyrrell, Hyde, and Dare Counties, North Carolina, where about 500 infested loblolly and pond pines were discovered in 40 spots. Most of the area contained jungle-like growth of low economic value, but control measures were started in high-value stands that were accessible.

Small spot infestations also appeared and spread on the Talladega National Forest, Alabama, on industrial lands in east-central Alabama, and on and near the Sumter National Forest in South Carolina. In the latter area, two-thirds of the infested trees were green, indicating optimum conditions for rapid brood development. Although control action was quickly started to prevent spread, continued beetle activity may be expected in 1960.

Ips Beetles Less Abundant Than Usual

The three species of Ips engraver beetles, *Ips avulsus* Eichh., *I. grandicollis* Eichh., and *I. calligraphus* Germ., often quite destructive in the pine-producing areas of the Southern and Southeastern States were less abundant in 1959 than for the past several years. Seasonal uptrends occurred in most of the States, but there were no serious outbreaks. Small groups of pines often were killed in the vicinity of trees struck by lightning, and moderate concentrations of single infested trees were observed in stands weakened by flooding and crowding.

In several areas, *Ips avulsus* Eichh. developed in logging slash and later spread to standing timber. These spot infestations were mostly localized, and not serious. Pines along the South Carolina coast were uprooted and broken by high winds in the early fall and unless the damaged material is salvaged, a buildup of *Ips* and other bark beetles will develop and attack undamaged timber.

Black Turpentine Beetle--A Major Pest

The black turpentine beetle, *Dendroctonus terebrans* Oliv., once considered of little economic importance in the South and Southeast, has become a serious forest pest, capable of killing the best trees in the forest. It has been especially prevalent in recent years in stands weakened by flooding and other disturbances.

During 1959 this beetle was a continuing problem on most of the national forests and on many State and private lands in the Gulf States. It was most active in flatwoods forests, along creek bottoms, and on low, poorly drained sites. Mechanized logging on wet soils resulted in excessive injury to tree roots. This damage, plus prolonged early summer flooding, created favorable conditions for beetle development. Prompt suppression prevented excessive timber mortality in most areas.

The black turpentine beetle was not a serious pest in the Southeastern States this year. Some damage was reported from various localities, but heavy populations were only found on the Chattahoochee National Forest in Georgia. Beetle attacks were associated with recent logging and lightning-damaged trees. There was no activity in adjoining green timber.

Infestation Of Little-Known Sawfly Required Suppressive Action

In September and October 1958, a little-known sawfly, *Neodiprion excitans* Roh., stripped foliage from loblolly and shortleaf pines on industrial lands in southeast Texas. Severely defoliated stands were well defined from the air and totaled about 25,000 acres. In early November, the larvae spun cocoons on and in the litter near tree bases, and occasionally in bark crevices.

During the winter, parasitic insects became unusually active and killed many of the developing sawflies in the cocoons. Hogs, armadillos, mice, and shrews destroyed many more and by early March an estimated 95 percent of the sawfly population had been wiped out. The few prepupae that survived, however, transformed to adults, and one or more additional broods developed during the late spring and early summer. By July 1, previously defoliated stands were again threatened. Aerial spraying with DDT was recommended to prevent tree mortality and further growth loss, and to discourage a possible increase of the southern pine beetle in the weakened

stands. Approximately 19,000 acres of the more heavily infested timber were sprayed in late July and early August. A larval disease, as yet undetermined, spread rapidly through the treated and untreated areas when the project was near completion. The dual action of the chemical and the disease, and the continued activity of parasites within surviving cocoons, reduced the sawfly to an endemic level.

This sawfly has also been a problem in the pine stands in north Florida during the past 3 years, defoliating valuable loblolly pine on some 300,000 acres. Weather, predators, and insect parasites caused a decline in the infestation during 1959 and natural enemies should continue to exert a controlling influence in 1960.

Red-Headed Pine Sawfly Damages Mid-South Plantings

The red-headed pine sawfly, *Neodiprion lecontei* (Fitch), was prevalent on young pines of all species in Louisiana and Texas. Isolated infestations were reported from Oklahoma, Arkansas, Alabama, and Mississippi. Repeated defoliation in some plantations killed enough trees so that spraying was done to prevent further damage. A severe outbreak in stands of loblolly and shortleaf pines on the Kisatchie National Forest, Louisiana, required aerial and ground spraying in June. The insecticide, together with heavy egg parasitism by a chalcid wasp, *Closterocerus cinctipennis* Ashm., appeared to have controlled the insect.

Virginia Pine Sawfly Spreads Southward

An epidemic of the Virginia pine sawfly, *Neodiprion pratti pratti* (Dyar), which has been present in Maryland and Virginia since 1954, spread southward into North Carolina. In the northern areas, Virginia and pitch pines are the primary hosts; farther south, shortleaf pine is favored. A marked increase in feeding intensity occurred during May in central Virginia and northeastern North Carolina, and throughout the pine type in the Coastal Plain and Piedmont of Virginia (fig. 11). Pine stands are more extensive in this relatively new zone of infestation. This greater abundance of suitable host material favors sawfly increase and spread.

Balsam Woolly Aphid Damages Recreational Areas

Fraser fir killed by the balsam woolly aphid, *Chermes piceae* (Ratz.), was of particular concern in the important scenic, recreational, and watershed areas around

Mount Mitchell in western North Carolina. There, an estimated 21,600 trees were killed during 1959. Heavy bole infestations occurred on almost all of the firs throughout the 7,100 acre spruce-fir type, and additional heavy killing of trees is expected in 1960. Attempts to suppress aphid populations by oil sprays and by systemic insecticides were not very successful. To gain control as rapidly as possible, major effort was made to introduce two important predators, *Aphidoletes thompsoni* Möhn and *Laricobius erichsonii* Rosenh., from foreign countries. Successful establishment has not yet been demonstrated.

Pine Leaf Chafers--A Future Problem?

During the spring the pine leaf chafer, *Pachystethus obliqua* (Horn), caused needle browning on 5,000 acres of two- to four-year-old loblolly pine in plantings in southeastern North Carolina. Beetles were active on almost every tree in the area in early June, but feeding subsided by July. Feeding was confined almost entirely to new growth, and injury consisted of a notch cut in each needle just above the bundle sheath. The needles bent down at this point and died, giving the trees a brownish appearance. Affected trees usually make a rapid recovery. However, growth reduction resulting from continued feeding could lessen the seedlings' ability to compete with hardwood undergrowth. The worst effects from the pest, therefore, may not be felt until future years.

Mite Infestations Occur On 10 Million Acres Of Pines

In early May, spider mites, *Oligonychus milleri* (McG.), infested about 10 million acres of loblolly and shortleaf pines in northern Louisiana and southern Arkansas. The conspicuous browning of the foliage of pines of all sizes caused alarm among foresters and timber owners, who feared that the trees would die. Young, open-grown or under-stocked even-aged stands were hardest hit, but both large and small trees were infested in some areas. Heavy rains in late May and early June eased the situation by knocking the mites off the needles. Trees in the affected areas made a good recovery. Similar short-lived outbreaks of spider mites on pine were observed in east Texas in 1954 and central Mississippi in 1955.



Figure 11. Larvae of the Virginia pine sawfly feed gregariously and defoliate many species of southern pines. Photo courtesy North Carolina Forest Service.

Other Pine Insects Important Pests

The Nantucket pine moth, *Rhyacionia frustrana* (Comst.), is the most common and widespread insect attacking young loblolly and shortleaf pine plantations in the South and Southeast. The insect became more important in 1959 because of the expanding planting program in the region.

The Texas leaf-cutting ant, *Atta texana* Buckley, caused mortality to naturally established and planted pine seedlings in west-central Louisiana and East Texas. Methyl bromide was used to fumigate destructive colonies.

The white-pine weevil, *Pissodes strobi* (Peck), caused moderate damage to plantations in local areas in the Southeast. The pine

spittlebug, *Aphrophora parallela* (Say), was plentiful in many other areas. Browning of Virginia and pitch pine foliage by the pine needle miner, *Exoteleia pinifoliella* (Chamb.), was common along most of the ridgetops from Hot Springs to Staunton, Virginia, and the pine leaf aphid, *Pineus pinifoliae* (Fitch), which alternates between red spruce and white pine, produced the heaviest galling of red spruce since 1951.

Hardwood Borers Cause Serious Lumber Degrade

Hardwood insects kill far fewer trees than do pine insects, but wood borers cause tremendous losses in value in living trees. External symptoms of infestation are indistinct or absent and the damage often goes unnoticed until timber is cut or logs are sawed (fig. 12). The more important wood borers causing damage and degrade of lumber in 1959 are the roundheaded and flatheaded borers and the carpenter moths.

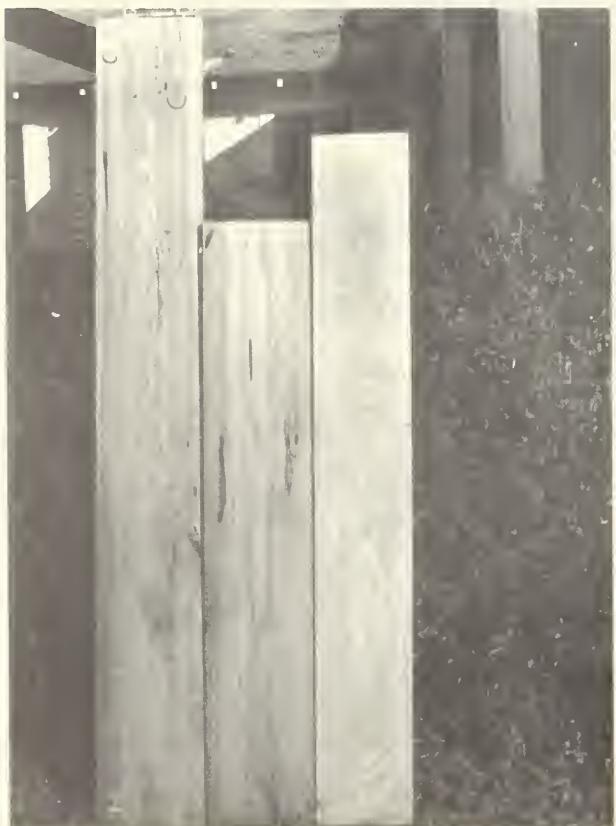


Figure 12. Defects caused by wood borers (left and center) reduce value of boards cut from oaks in Southern States.

Caterpillars Strip Southern Hardwoods

During the spring of 1959 the forest tent caterpillar, *Malacosoma disstria* Hbn., stripped

large areas of bottom-land hardwoods in southern Louisiana and Alabama and parts of Mississippi. Hardwoods suffered severe damage along the West Virginia-Virginia State line. In Louisiana, feeding was lighter in the 40,000-acre area infested last year, although defoliation of tupelo and blackgum was intense west of New Orleans. Caterpillars spun their cocoons in early May and moths were in flight 2 weeks later. By June, trees had refoliated but leaves were smaller and less abundant than normal. Sweetgum, river birch, willow oak, and overcup oak on 150,000 acres along the Alabama River bottom were heavily defoliated. Many sweetgums as far north as Jackson, Alabama, were completely stripped. Infestations also were seen in Clarke and Washington Counties, Alabama, and Wayne County, Mississippi.

Many of the caterpillars in all areas were infected with a fungus, and parasitized by tachinid and sarcophagid flies, *Achaetoneura* sp. and *Sarcophaga houghi* Ald., respectively.

The elm spanworm, *Ennomos subsignarius* (Hbn.), has been an important defoliator of oaks, hickories, and other hardwoods in the mountains of Georgia, Tennessee, and North Carolina for the past few years. Infestations, first discovered in northern Georgia in 1954, spread over an area of 860,000 acres in these States. Although the outbreak increased by about 290,000 acres since 1958, the intensity of defoliation was markedly lower. There were no areas of heavy feeding in 1959, in contrast to about 31,000 acres of heavy to complete defoliation last year. Results of egg mass surveys and studies of natural enemies indicate that defoliation will continue to decline, especially in the western part of the outbreak area. The adverse effects of repeated defoliation on tree growth and vigor, however, may continue for many years. In northern Georgia, where successive attacks have occurred for 5 years, many oaks and hickories have died.

Moderate to complete defoliation of various species of oak was reported in many areas during September and October. The orange-striped oak worm, *Anisota senatoria* (J. E. Smith), the yellow-necked caterpillar *Datana ministra* (Drury), and the variable oak leaf caterpillar, *Heterocampa manteo* (Dbldy.), were the insects most often responsible. Defoliation occurred on thousands of acres of oaks in Jasper and Newton Counties, Texas, and in southwestern Louisiana and northeast Mississippi.

Northeast

Highlights

1. The spruce budworm caused medium to heavy defoliation of balsam fir stands on approximately 105,000 acres in Maine, and light populations were found in some of the area sprayed for control in 1958.

2. The balsam woolly aphid continued as a major pest of balsam fir in Vermont, New Hampshire, New York, and Maine.

3. The white-pine weevil and the European pine shoot moth were destructive to many pine plantations in all of the Northeastern States.

Spruce Budworm Infestations Increase In Maine

The scope and severity of infestations of the spruce budworm, *Choristoneura fumiferana* (Clem.), increased in Maine, with 250,000 acres of continuous defoliation in southeastern Aroostook County. Light populations were found in parts of the area sprayed for control in 1958. Noticeable feeding in the State covered 940,000 acres. Areas of medium to heavy defoliation totaled 105,000 acres. The largest part of this, about 90,000 acres, occurred in a band west of Highway Route 11 and Portage Lake. The western boundary of the infestation remained almost stationary for the past several years. Spread has been eastward with the prevailing winds. Damage will probably be more serious in 1960. The worst infestations will be sprayed.

Balsam Woolly Aphid Destructive

The balsam woolly aphid, *Cermea piceae* (Ratz.), is one of the most destructive forest insects in the Northeast. On the Green Mountain National Forest in Vermont, for example, some 20 percent of the merchantable volume of balsam fir has been killed by the aphid since 1951. Approximately 75 percent of the timber stands were heavily infested in 1959. Conditions in New Hampshire, New York, and Maine are comparable to those described for Vermont.

In an attempt to control the aphid by biological means, effort was increased during the year to introduce and establish insect predators from abroad. Some 1,100 adults of the fly predator, *Aphidoletes thompsoni* Möhn, and 15,330 adults of the predaceous beetle,

Laricobius erichsonii Rosenh., were introduced and liberated on the Penobscot Experimental Forest in Maine.

White Pine Weevil Deterrent To Pine Production

Numerous reports of the white-pine weevil, *Pissodes strobi* (Peck), some of which indicated increased damage, showed that this insect was still the most serious deterrent to the production of white pine in the Northeast. Weevils were more abundant in New Hampshire, and heavily damaged young plantations throughout New York. In Forest County, Pennsylvania, much Austrian pine was attacked, but nearby white and Scotch pines were only lightly affected.

Control efforts against the weevil were stepped up during the year; various materials and methods were tested. Field tests of airplane and helicopter applications of DDT and other toxicants gave inconsistent results, ranging from excellent control to poor.

Virginia Pine Sawfly Widespread

The Virginia pine sawfly, *Neodiprion pratti* (Dyar), has been epidemic in Maryland and small areas in northern Virginia since 1954. In Maryland, where some of the oldest infestations occur, defoliation intensity increased slightly. Sawflies are present in most pine stands, and damage persists along the Patuxent River drainage, where part of the initial outbreak was discovered. Some mixed Virginia and pitch pine stands have withstood 5 years of attack and no extensive stand mortality has been directly attributed to sawfly feeding.

Other Sawflies Defoliate

The European pine sawfly, *Neodiprion sertifer* (Geoff.) continued to severely defoliate red and Scotch pines in southern New York, Connecticut, northern New Jersey, and northeastern Pennsylvania. The red-headed pine sawfly, *N. lecontei* (Fitch), again was abundant on young pines in New York.

Early summer and fall feeding by the sawfly, *Neodiprion pini-rigidae* (Nort.), was common on pitch pine in southern New Jersey, with complete defoliation in scattered locations.

Plantations Damaged By Many Insects

The European pine shoot moth, *Rhyacionia buoliana* (Schiff.), continued to damage valuable plantings of red and Scotch pines in the western two-thirds of the Northeastern States. Another shoot moth, *Eucosma gloriola* Hein., caused substantial twig killing of red, Scotch, white, and Austrian pines in several counties in Pennsylvania. The Nantucket pine moth, *R. frustrana* (Comst.), severely attacked many young loblolly pine plantations along the eastern shore of Maryland. Scattered infestations were reported elsewhere in the eastern part of the State.

The pine engraver, *Ips pini* (Say), continued its depredations throughout the Northeast. Increasing populations were found in western New York. If rainfall deficiencies continue, more serious trouble may develop.

The balsam gall midge, *Dasyneura balsamicola* (Lint.), troubled Christmas tree growers in Vermont, and the pales weevil, *Hylobius pales* (Hbst.), severely damaged Scotch and white pine Christmas tree plantings in Pennsylvania and New York. Heavy attacks by the pine root-collar weevil, *H. radicis* Buch., occurred in red and Scotch pine plantations in Warren, Saratoga, and Lewis Counties, New York, and almost wiped out a Scotch pine Christmas tree plantation at Shelton, Connecticut. Conspicuous browning of pitch pine and Virginia pine resulted from feeding by the pine needle miner, *Exoteleia pinifoliella* (Chamb.), in Kent and Newcastle Counties, Delaware; southern New Jersey; and, the Myles Standish State Park, Massachusetts. The eastern spruce gall aphid, *Chermes abietis* L., was active in New York, Pennsylvania, Maryland, and Maine. The Cooley spruce gall aphid, *C. cooleyi* Gill., was abundant on introduced Colorado blue spruce, Engelmann spruce, and Douglas-fir throughout New York; 50 percent of the spruce twigs were distorted in some areas.

Gypsy Moth a Continuing Problem¹

Winter and spring weather of 1959 favored development of the gypsy moth, *Porthetria dispar* (L.). Some winterkill of eggs above snowline occurred in certain spots in northern Vermont, but there were no reports of larval kill by late spring frost. Observations on egg hatch, larval development, and

subsequent feeding indicated a buildup of populations in scattered centers throughout the infestation area in New England and eastern New York (fig. 13).



Figure 13. Eggs, larvae, pupae, and adults of the gypsy moth on a bark section of oak.

Aerial surveys showed 14,467 acres of defoliation, distributed as follows: Maine, 1,000; New Hampshire, 4,000; Vermont, 1,500; Massachusetts, 382; Connecticut, 5,980; and New York in the Upper Hudson and Champlain Valley areas, 1,605.

The program designed to eliminate the gypsy moth from its western boundaries was continued in peripheral areas of infestation in New York. Some 80,000 acres in southeastern Otsego and northeastern Delaware Counties were sprayed with Sevin-paraffin-oil suspension. This control program was undertaken cooperatively by the State Department of Agriculture and Markets, the State Conservation Department, the State College of Agriculture, and the Plant Pest Control Division, U.S. Department of Agriculture.

Tent Caterpillars In Outbreak Status

Defoliation of maple, aspen, oak, and other hardwoods by the forest tent caterpillar, *Malacosoma disstria* Hbn., was more conspicuous and widespread than in 1958, especially in Pennsylvania, Maryland, and

¹Information from Plant Pest Control Division, Agricultural Research Service.

West Virginia. The prevalence of current overwintering egg masses indicates serious defoliation in early 1960 unless weather, parasites, and diseases intervene. The caterpillars will kill trees in the more southerly portions if rainfall deficiencies continue, especially on ridges where weakened trees succumb first.

The eastern tent caterpillar, *M. americanum* (F.), attained the largest numbers in recent years and stripped leaves from the wild cherry and fruit orchard trees in Delaware, Maryland, Rhode Island, and New York State.

Miscellaneous Hardwood Insects Destructive

Record populations of the birch leaf miner, *Fenusia pusilla* (Lep.), occurred in New York, resulting in complete defoliation in some areas. Infestations also occurred in

Vermont, Massachusetts, and New Jersey. Approximately 3,000 acres of aspen in Essex County, New York, were defoliated by the large aspen tortrix, *Archips conflictana* (Wlkr.), in combination with the fruit tree leaf roller, *A. argyrospila* (Wlkr.). The solitary oak leaf miner, *Cameraria hamadryadella* (Clem.), sometimes in association with the gregarious oak leaf miner, *C. cincinnatella* (Chamb.), was responsible for blotching and leaf shedding of white oak in Massachusetts, Rhode Island, and Orange County, New York. The satin moth, *Stilpnota salicis* (L.), again stripped lombardy poplar in scattered parts of New York State.

There was a general outbreak of the beech scale, *Cryptococcus fagi* (Baer.), along the Hudson River Valley with a heavy localized infestation near Warrensburg, New York. The scale was also reported abundant in New Hampshire. The presence of the *Nectria* fungus of beech, often associated with the insect, was not indicated.

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